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A POWER GENERATION SYSTEM INCLUDING AN APPARATUS  
FOR ATTACHING A GENERATOR STATOR CORE TO A  
FRAME SUPPORT AND ASSOCIATED METHODS

TO WHOM IT MAY CONCERN, THE FOLLOWING IS A SPECIFICATION  
OF THE AFORESAID INVENTION

**A POWER GENERATION SYSTEM INCLUDING AN APPARATUS  
FOR ATTACHING A GENERATOR STATOR CORE TO  
FRAME SUPPORT AND ASSOCIATED METHODS**

**Related Applications**

The application is related to U.S. Patent Application  
Serial No. <sup>11M</sup> 00P9078US filed on 12/18/00 by the same inventor  
which is incorporated herein by reference in its entirety.

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**Field of The Invention**

This invention is related to the power generation  
industry and, more particularly, to the field of mounting  
frames supporting stator cores.

10

**Background of the Invention**

In the power generation industry, generator stator  
cores are supported on mounting frames. As is known in  
the art, generator stator cores generally include keybars  
15 positioned along an outer peripheral surface of the  
generator stator core. During operation of a power  
generation system, the generator stator core experiences  
an "oval mode" condition during which the generator stator  
core cyclicly deforms. The generator stator core  
20 temporarily deforms into an oval shape during operation.  
The deformations take place along both the horizontal and  
vertical axis. The "oval mode" condition experienced by  
the generator stator core accounts for some of the

tangential and radial forces on a power generation system. Manufacturers of power generation systems are often faced with the problem of designing an efficient stator core frame support that can compensate for the "oval mode" condition experience by generator stator cores. Current frame supports are very large and inefficient.

Power generation systems also experience transient faults during operation. When the power generation system experiences a transient fault, the generator stator core is suddenly displaced or rotated and it is difficult for a frame or frame support to sustain the forces associated with the transient fault. Manufacturers and users of high voltage generator stator cores often have great difficulty providing an efficient support for the generator stator core. In order to provide a frame support that is sufficient enough to sustain the forces associated with transient faults experienced during operation of the generator stator core, the frame support is normally very large and extremely inefficient.

Some generator stator core support frames incorporate an outer frame surrounding the core that is then attached to a bedplate or lower frame such as seen in U.S. Patent No. 6,091,177 by Carbonell et al. titled "*Spring Mounting For An Electric Generator.*" The mounting frame surrounds the core and connects to all of the keybars positioned on the outer peripheral portions of the core. The surrounding frame is then attached to a lower frame using side and lower connecting members. The combination of these connecting members provides a support frame that is inefficient and cumbersome. Furthermore, the combination of the surrounding frame and the support frame provides a support apparatus with an increased load path, i.e., the load from transient faults and vibratory forces must travel an increased distance.

A similar arrangement for such an apparatus can be found in U.S. Patent No. 4,891,540 by Cooper et al. titled "Generator Core Support System." This support system connects to the generator stator core around the outer  
5 periphery of the generator stator core where the keybars are positioned. Similarly, the support system provides a complex and inefficient connection between the generator stator core and the support frame. This connection does not relieve lateral and tangential forces associated with  
10 transient faults. Accordingly, excess force from transient faults can cause damage to the generator stator core and frame if the core is not properly fastened to a frame support that can withstand these forces.

As understood by those skilled in the art, it is  
15 common to support a power generator stator core on a support frame that includes a connecting member between the generator stator core and the frame support in the six o'clock or twelve o'clock positions, i.e., a connecting member between the lower outer portion of the generator  
20 stator core and the stator core frame support. It is also common to support a power generator stator core on a support frame that includes a connecting member between the generator stator core and the frame support in the twelve o'clock position, i.e., a connecting member between  
25 an upper outer portion of the generator stator core and the stator core frame support. These configurations of frame supports provide inefficient connections that do not allow for the elimination of lateral forces associated with transient faults that occur during operation.

30 Additionally, it is costly and time consuming to provide support systems for power generators due to the cumbersome size and configuration of the current support frames necessary for accommodating transient faults and the "oval mode" condition experienced by power generation  
35 systems during operation. Some current support systems

are so cumbersome that it is not possible to assemble the core and the core support system separate from one another. Presently, the core and the core support system must be constructed simultaneously. The simultaneous  
5 construction of the core and the support frame is extremely costly and time consuming.

### Summary of the Invention

In view of the foregoing, the present invention  
10 advantageously provides a high voltage power generation system including an apparatus for attaching a generator stator core to a frame support and methods of stabilizing a power generation system and reducing vibration and eliminating lateral movement of a generator stator core  
15 during operation that are efficient and cost effective. The present invention also advantageously provides an apparatus and methods for protecting a power generation system from the forces associated with transient faults and compensating for deformations that result in radial  
20 and tangential forces that are encountered when the generator stator core experiences an "oval mode" condition.

More particularly, the present invention provides a power generation system that includes a stator core frame  
25 support member having a lower inner surface portion and a lower outer surface portion. The lower inner surface portion preferably has a substantially semi-annular shape, and the lower outer surface portion is positioned to contact a support surface. The system also includes a  
30 generator stator core having a substantially annular shape. The generator stator core includes a plurality of keybars positioned spaced-apart and extending along outer peripheral portions of the generator stator core. The generator stator core is positioned to overlie the lower  
35 inner surface portion of the stator core frame support

member and has a lower end portion positioned spaced-apart from and not in contact with bottom portions of the lower inner surface of the stator core frame support member. The upper end portion of the generator stator core is also  
5 positioned spaced-apart from and not in contact with the stator core frame support. The system further includes a core supporter connected to the stator core frame support member. The core supporter is positioned to contact a plurality of keybars that are positioned along outer side  
10 peripheries of the generator stator core. The core supporter preferably has first and second core connecting means for attaching the stator core frame support member to the generator stator core. The core connecting means relieves vibration and prevents lateral movement of the  
15 generator stator core and also stabilizes the power generation system during operation to thereby provide a stator core frame support member that is efficient and cost effective. The first core connecting means is connected to a first medial side outer peripheral portion  
20 of the generator stator core and the second core connecting means is connected to a second medial side outer peripheral portion of the generator stator core. The second medial side outer peripheral portion of the generator stator core is positioned opposite the first  
25 medial side outer peripheral portion of the generator stator core. The first and second core connecting means are positioned symmetrically along the longitudinal axis of the generator stator core. The combination of the first and second core connecting means connect portions of  
30 the stator core frame support member to portions of the generator stator core.

This configuration of a the generator stator core and the stator core frame support provides a stable power generation system. This configuration also advantageously  
35 relieves vibration and prevents lateral movement of the

generator stator core associated with transient faults that occur during operation. This configuration still further advantageously compensates for tangential and radial forces encountered by the power generation system  
5 when the generator stator core experiences the "oval mode" condition. By relieving vibration and eliminating lateral movement of the generator stator core and by further stabilizing the power generation system, a smaller and more efficient generator stator core frame support member  
10 is provided. The present invention relieves vibration and prevents lateral movement of the generator stator core by providing a plurality of connections between the generator stator core and the stator core frame support member along medial side portions of the generator stator  
15 core. The power generation system is further stabilized by eliminating a support contact between a bottom portion of the generator stator core and the stator core frame support. The power generation system is still further stabilized by eliminating a support contact between a top  
20 portion of the generator stator core and the stator core frame support. These configurations of the power generation system advantageously eliminate lateral force components associated with transient faults, reduces vibratory forces associated with operation of the  
25 generator stator core, stabilizes the power generation system, and further advantageously reduces costs and time associated with providing a support frame for a high voltage generator stator core. These configurations of the power generation system also advantageously compensate for  
30 temporary deformations of the power generation stator core when the generator stator core experiences an "oval mode" condition during operation.

The present invention still further provides a generator stator core support apparatus for stabilizing a  
35 power generation system and for relieving vibration and

eliminating lateral movement of the generator stator core during operation. The generator stator core support apparatus preferably includes first core connecting means for connecting the generator stator core to a stator core frame support when the generator stator core is positioned to overlies lower inner surface portions of the stator core frame support. The first core connecting means is positioned to contact a first outer peripheral medial side portion of the generator stator core and to contact a first upper medial side portion of the stator core frame support. The generator stator core support apparatus also includes second core connecting means for connecting the generator stator core to the stator core frame support. The second core connecting means is positioned to contact a second outer peripheral medial side portion of the generator stator core. The second outer peripheral medial side portion is positioned opposite the first outer peripheral medial side portion of the generator stator core. The second core connecting means is further positioned to contact a second upper medial side portion of the stator core frame support. The second medial side portion of the stator core frame support is positioned opposite the first medial side portion of the stator core frame support. The combination of the first and second core connecting means connects portions of the generator stator core to portions of the stator core frame support to thereby stabilize the power generation system and relieve vibration and prevent lateral movement of the generator stator core during operation. The combination of the first and second core connecting means is further positioned to support the generator stator core when connected thereto without a support contact between a lower end portion of the generator stator core and the lower inner surface portions of the stator core frame support or a support contact between an upper end portion



of the generator stator core and the inner surface portions of the stator core frame support. There is no longer a stiff support between the generator stator core and the stator core frame support when the connecting support is eliminated between the lower end portion or the upper end portion of the generator stator core and the stator core frame support. By providing an interstitial space between the upper and lower end portions of the generator stator core and the inner surface portions of the stator core frame support, lateral forces associated with transient faults that occur during operation of the generator stator core are eliminated. This interstitial space also relieves vibration of the generator stator core during operation and compensates for temporary deformations that produce tangential and radial forces encountered by the generator stator core while experiencing an "oval mode" condition during operation. By relieving vibration, eliminating lateral movement, stabilizing the power generation system and compensating for the "oval mode" condition, the present invention advantageously decreases the load from the generator stator core to the stator core frame support. The decreased load allows for a smaller and more efficient stator core frame support. A smaller frame advantageously provides a shorter load path along which the load from the generator stator core to the stator core frame support must travel. This configuration further advantageously reduces costs and time associated with providing a support frame for a high voltage generator stator core thereby providing an efficient stator core frame support.

The present invention also provides a method of stabilizing a power generation system, relieving vibration, and eliminating lateral movement of the generator stator core during operation. The method includes the step of attaching a first core supporter

which has a biasing support member that includes an elongate spring bar to a first upper medial side portion of a stator core frame support. The method also includes attaching a second core supporter which also has a biasing support member with an elongate spring bar to a second upper medial side portion of the stator core frame support. The second upper medial side portion is positioned opposite the first upper medial side portion so that the combination of the first and second core supporters is positioned symmetrically along portions of the frame support. The method further advantageously includes positioning the generator stator core having a substantially annular shape to overlies lower inner surface portions of the stator core frame support having a semi-annular shape, connecting the generator stator core to the first core supporter along a first medial side portion of the generator stator core, and connecting the second core supporter to a second medial side portion of the generator stator core. The second medial side portion is preferably positioned opposite the first medial side portion of the generator stator core, and the combination of the connections between the first and second core supporters and the first and second medial side portions of the generator stator core form a connection between the generator stator core and the stator core frame support. The connection between the generator stator core and the stator core frame support advantageously reduces vibration and eliminates lateral forces experienced by the generator stator core, and provides stabilization to the power generation system during operation without a support contact between a lower end portion of the generator stator core and the lower inner surface portions of the stator core frame support or a support contact between an upper end portion of the generator stator core and the stator core frame support.

The method of stabilizing the power generation system provided by the present invention is advantageously reduced in cost. The method further advantageously reduces the time associated with constructing a frame support to  
5 stabilize the power generation system. The method also advantageously eliminates lateral force components and reduces vibration forces associated with transient faults during operation of the high voltage generator stator core. The method still further advantageously provides a  
10 stator core frame support that is efficient, cost effective, and can compensate for the vertical and horizontal force components associated with the "oval mode" condition experienced by the generator stator core during operation. The method also advantageously  
15 decreases the path along which a load must travel between the generator stator core and the stator core frame support.

#### **Brief Description of the Drawings**

20 Some of the features, advantages, and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view of a first  
25 embodiment of a generator stator core of a power generation system positioned to overlie and mounted to a stator core frame support according to the present invention;

FIG. 2 is a sectional view of a generator stator  
30 core of a power generation system mounted to a stator core frame support and taken through line 2-2 of FIG. 1 according to the present invention;

FIG. 3 is a front perspective view of a core connector that includes a spring bar, spring mounting

frames, and bracket spring assemblies according to the present invention;

FIG. 4 is a rear perspective view of a core connector that includes a spring bar, spring mounting  
5 frames, and bracket spring assemblies according to the present invention;

FIG. 5 is a fragmentary perspective view of a connecting assembly between the generator stator core and the stator core frame support member of a power  
10 generation system according to the present invention;

FIG. 6 is a perspective view of a second embodiment of a generator stator core positioned to overlies and mounted to a stator core frame support of a power generation system according to the present invention;

FIG. 7 is a fragmentary perspective view of second  
15 embodiment of a connecting assembly between the generator stator core and the stator core frame support member of a power generation system according to the present invention;

FIG. 8 is a front perspective view of a second  
20 embodiment of a core connector that includes a spring bar passing through spring mounting frames with bracket spring assemblies according to the present invention;

FIG. 9 is a fragmentary perspective view of a third  
25 embodiment of a connecting assembly between a generator stator core and a stator core frame support having a plurality of spring bars according to the present invention; and

FIG. 10 is a front perspective view of third  
30 embodiment of a core connector including a plurality of spring bars according to the present invention.

#### **Detailed Description of Preferred Embodiments**

The present invention will now be described more  
35 fully hereinafter with reference to the accompanying

drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein.

5 Rather, these illustrated embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, and prime, double prime, and triple prime  
10 notations, if used, indicate similar elements in alternative embodiments.

During operation of power generation systems, high voltage generator stator cores experience vibration forces, transient faults, and an "oval mode" condition  
15 that includes both tangential and radial forces applied to the power generation system. Transient faults cause the high voltage generator stator core to displace and further put high strains on stator core frame support members during operation. The lateral displacement of the  
20 generator stator core, for example, can be of the same order of magnitude as torsional displacements due to torsional forces experienced by the generator stator core during operation. The displacements, high vibratory forces, and tangential and radial forces associated with  
25 the "oval mode" condition experienced by generator stator cores during operation cause high levels of strain on stator core frame support members positioned to support the generator stator core. By low tuning the natural frequency of the generator stator core, the power  
30 generation system is advantageously reduced in size, complexity and cost.

FIG. 1 illustrates a power generation system **10** that reduces vibratory forces and eliminates lateral force components associated with transient faults and reduces  
35 tangential and radial forces associated with the "oval

mode" condition and low tunes the natural frequency of a generator stator **20** during operation. The power generation system **10** includes a stator core frame support member **30** having a lower inner surface portion **32** and a lower outer surface portion **34**. The lower outer surface portion **34** is positioned to rest on a support surface, such as a concrete floor, for example. The lower inner surface portion **32** of the stator core frame support **30** preferably has a substantially semi-annular shape, but other shapes, e.g., rectangular or oval, could also be used as well according to the present invention.

The generator stator core **20** can have a substantially annular shape, but other shapes could also be used as well according to the present invention. The generator stator core **20** preferably includes a plurality of keybars **22**. The keybars **22** can advantageously be made of a steel material. The plurality of keybars **22** are preferably positioned spaced-apart and extend along outer peripheral portions of the generator stator core **20**. The generator stator core **20** is positioned to overlies the stator core frame support member **30** and can advantageously include substantially less than the maximum number of keybars that can be positioned spaced-apart along outer peripheral portions of the generator stator core **20**.

In a second embodiment of the present invention, the generator stator core **20'** can still further advantageously include four keybars **22'**, as illustrated in FIG. 6. Two keybars **22'** can be positioned spaced-apart along a first outer peripheral medial side portion **27'** of the generator stator core **20'**, and another two keybars **22'** can be positioned spaced-apart along a second outer peripheral medial side portion **28'** of the generator stator core **20'**. The first **27'** outer peripheral medial side portion is

positioned opposite the second **28'** outer peripheral medial side portion of the generator stator core **20'** so that the first **27'** and the second **28'** outer peripheral medial side portions are positioned substantially symmetrical along a preferably longitudinal axis of the generator stator core **20'**.

The keybars **22** are elongate and extend substantially the entire length of the generator stator core **20**. The outer periphery of the generator stator core **20** is preferably provided with dovetail slots **26** that extend substantially the entire length of the generator stator core **20**. The dovetail slots **26** are wider at the bottom portion of the slots **26** and more narrow at the upper portion of the slots **26**. Each of the plurality of keybars **22** has portions shaped similar to the dovetail slots **26**. Likewise, the inner portions of the keybars **22** are preferably wider than the outer portion of the keybars **22**. The keybars **22** matingly contact the respective dovetail slots **26** formed in the outer peripheries of the generator stator core **20**.

The power generation system **10** further provides a core supporter connected to the stator core frame support member **30**. The core supporter is further positioned to contact the keybars **22** positioned along outer peripheral portions of the generator stator core **20**. The core supporter preferably includes core connecting means **42** for attaching the stator core frame support member **30** to the generator stator core **20**. The core connecting means preferably includes first **43** and second **44** core connecting means. Each of the first **43** and second **43** core connecting means preferably includes a biasing support member **50**. The biasing support member **50** encompasses structural properties that provide strength for supporting a

connection between the generator stator core **20** and the stator core frame support member **30**. The biasing support member **50** also includes structural properties that provide a supporting connection between the generator stator core **20** and the stator core frame support member **30** that is not rigid. The biasing support member **50** further provides a level of flexure that reduces vibration of the generator stator core **20**, eliminates lateral force components associated with transient faults that occur during operation of the generator stator core **20** and low tunes the natural frequency of the generator stator core **20**.

The structural properties of the biasing support member **50** also advantageously aid in reducing tangential and radial forces associated with the "oval mode" condition experienced by the generator stator core **20** during operation to thereby reduce complexity and cost of the power generation system **10** while simultaneously maintaining stability of the power generation system **10**. The biasing support member **50** can advantageously be provided by an elongate spring bar **52**. The spring bar **52** is positioned between the generator stator core **20** and the stator core frame support member **30** to thereby provide a connector assembly that connects the generator stator core **20** and the stator core frame support member **30**.

The connector assembly is structurally viable and has flexural properties sufficient to absorb vibratory forces, eliminate lateral force components associated with transient faults, low tune the natural frequency of the generator stator core, and stabilize the power generation system **10** during operation of the generator stator core **20**. More particularly, the spring bar **52** is connected to a spring mounting frame **56**. The spring mounting frame **56** is connected to the keybars **22** of the generator stator



core **20** as illustrated in FIG. 5. The spring bar **52** can be composed of steel or another type of material that provides structural support and flexural properties suitable for relieving vibration of a generator stator core **20**, eliminating lateral force components associated with transient faults, reduce tangential and radial force components associated with the "oval mode" condition, and low tune the natural frequency of the generator stator core **20** during operation. The flexural properties of the spring bar **52** also advantageously aid in eliminating rigid connections in power generation systems **10**.

The first **43** and second **44** core connecting means advantageously relieve vibratory, tangential and radial forces associated with operation of the generator stator core **20**, eliminate lateral movement, low tune the natural frequency of the generator stator core **20**, and further advantageously stabilize the power generation system **10**. The first core connecting means **43** is connected to a first medial side outer peripheral portion **27** of the generator stator core **20**. The second core connecting means **44** is connected to a second medial side outer peripheral portion **28** of the generator stator core **20**. The first medial side outer peripheral portion **27** of the generator stator core **20** is positioned opposite the second medial side outer peripheral portion **28** of the generator stator core **20** and is therefore positioned substantially symmetrical along the longitudinal axis of the generator stator core **20**. The combination of the first **43** and second **44** core connecting means connect portions of the generator stator core **20** to portions of the stator core frame support member **30**.

The biasing support member **50** can also advantageously include a plurality of bracket spring assemblies **54**. The

spring bar 52 is advantageously connected to the bracket  
spring assembly 54 as illustrated in FIGS. 3-5. The  
bracket spring assemblies 54 can be positioned spaced-  
apart along the elongate spring bar 52. Each of the  
5 plurality of bracket spring assemblies 54 also includes a  
spring mounting frame 56 and a plurality of spaced-apart  
key block brackets 60. The spring bar 52 connects to each  
of the plurality of bracket spring assemblies 54 along  
center portions of the bracket spring assemblies 54. More  
10 particularly, the spring bar 52 is positioned to connect  
to outer center portions of each of the plurality of  
bracket spring assemblies 54. The spring bar 52 can  
connect to the bracket spring assemblies 54 by welding  
exterior portions of the bracket spring assemblies 54 to  
15 portions of the spring bar 52. The spring bar 52 can also  
connect to the bracket spring assemblies 54 using any  
other type of connection that can be made between metals  
that has the structural and flexural properties to reduce  
vibration and eliminate lateral forces of the generator  
20 stator core 20 and to further stabilize the power  
generation system 10 during operation.

In a third embodiment of the present invention, the  
spring bar 52" can connect to the bracket spring  
assemblies 54" through a center portion of the bracket  
25 spring assemblies 54" as illustrated in FIGS. 7-8. In  
this embodiment, the bracket spring assemblies 54" include  
an opening 59" formed in a medial portion. The dimensions  
of the opening 59" are substantially similar to the  
dimensions of the spring bar 52". A connection is made  
30 between the spring bar 52" and the bracket spring  
assemblies 54" by slidably engaging the elongate spring  
bar 52" with the opening 59" formed in each of the  
plurality of bracket spring assemblies 54". The

connection between the spring bar **52"** and the bracket spring assemblies **54"** can be strengthened by welding portions of the spring bar **52"** to portions of the bracket spring assemblies **54"** along the openings **59"** formed in the  
5 medial portions of the bracket spring assemblies **54"**.

In a fourth embodiment of the present invention, a plurality of spring bars **52"'** can be provided, as illustrated in FIGS. 9-10. The stiffness of the plurality of spring bars **52"'** combined, i.e., as illustrated in FIG.  
10 9, is substantially similar to the stiffness of a single spring bar **52**, i.e., as illustrated in a first embodiment of the present invention in FIG. 5. The plurality of spring bars **52"'** also includes a plurality of bracket spring assemblies **54"'** positioned spaced-apart along the  
15 plurality of elongate spring bars **52"'**. The plurality of spring bars **52"'** extend substantially parallel to each other substantially the entire length of the generator stator core **20"'**. The plurality of spring bars **52"'** are advantageously connected to the plurality of bracket  
20 spring assemblies **54"'** along end portions of the bracket spring assemblies **54"'** so that the plurality of spring bars **52"'** are positioned opposite each other and symmetrical along the bracket spring assemblies **54"'**. This configuration of the present invention is  
25 advantageous because each of the plurality of spring bars **52"'** can advantageously have a lower stiffness than in the first embodiment of the present invention where only a single spring bar **52** per core supporter is included. This configuration also advantageously reduces vibration and  
30 eliminates lateral movement of the generator stator core **20"**, low tunes the natural frequency of the generator stator core **20**, and further advantageously stabilizes the power generation system **10"** during operation. This

configuration still further advantageously compensates for tangential and radial forces associated with the "oval mode" condition experienced by the generator stator core 20" during operation.

5       The key block brackets 60 are connected to the spring mounting frame 56 as illustrated in FIGS. 3-4. More particularly, the plurality of key block brackets 60 include first 61 and second 62 key block brackets. The first key block bracket 61 is positioned to connect to a  
10       first end portion of the spring mounting frame 56 and the second key block bracket 62 is positioned to connect to a second end portion of the spring mounting frame 56. The first key block bracket 61 preferably includes a first key block 64 and the second key block bracket 62 includes a  
15       second key block 64. The first and second key blocks 64 are positioned to matingly contact the first and second key block brackets 60.

One of the plurality of key blocks 64 is also positioned to contact one of the plurality of keybars 22  
20       positioned along the outer peripheral portions of the generator stator core 20 and is further positioned to contact the stator core frame support 30. The plurality of key blocks 64 are positioned to contact portions of the generator stator core 20 and portions of the stator core  
25       frame support 30. As illustrated in FIGS. 3-5, each of the plurality of key block brackets 60 and each of the plurality of key blocks 64 includes openings 68 that align with one another. Each of the plurality of keybars 22 can also include a plurality of openings 68. The openings 68  
30       in the key block brackets 60, the key blocks 64, and the keybars 22 can advantageously be threaded. When the openings 68 on the key blocks 64, the key block brackets 60, and the key bars 22 are aligned, a connection can be

made between the generator stator core **20** and the stator core frame support **30** by positioning a connecting member **15** therethrough.

The connecting member **15** can advantageously be  
5 provided by a bolt, or another type of connecting assembly that can pass through portions of the key block bracket **60**, the key block **64**, and the key bar **22**. The connecting member **15** can be any strong steel material that can withstand vibratory, radial, and vertical forces  
10 associated with the operation of the generator stator core **20** or lateral movement associated with transient faults. The connecting member **15** can also be threaded to thereby make a strong connection to the threaded openings **68** positioned on the key block **64**, the key block brackets **60**,  
15 and the key bar **22**.

The core supporter can advantageously be positioned to contact less than all of the keybars **22** positioned along outer peripheral portions of the generator stator core **20**, as illustrated in FIG. 2. This configuration  
20 advantageously reduces cost and complexity of the power generation system **10** by low tuning the natural frequency of the generator stator core, relieving vibratory forces, preventing lateral movement and compensating for tangential and radial forces associated with the "oval  
25 mode" condition experienced by the generator stator core **20** during operation while simultaneously maintaining stability of the power generation system **10**. Because the core supporter can be positioned to contact less than all of the keybars **22**, the configuration is advantageously  
30 less expensive to manufacture and less time consuming to assemble.

As illustrated in FIGS. 3-5, a generator stator core support apparatus for stabilizing a power generation

system **10** is also provided. The generator stator core support apparatus includes first **43** and second **44** core connecting means **42** for connecting the generator stator core **20** to a stator core frame support **30**. The first core  
5 connecting means **43** is positioned to contact a first outer peripheral medial side portion **27** of the generator stator core **20** and is also positioned to contact a first upper medial side portion of the stator core frame support **30**. The contact made between the first core connecting means  
10 **43** and the first upper medial side portion **27** of the stator core frame support **30** forms a connection between the first core connecting means **43** and the stator core frame support **30**. This connection can be formed by a weld or any other connection between metal material that forms  
15 a strong bond that will not deteriorate over the life of the generator stator core **20**.

The second core connecting means **44** is positioned to contact a second outer peripheral medial side portion **28** of the stator core frame support **30**. The second outer  
20 peripheral medial side portion **28** of the stator core frame support **30** is positioned opposite the first outer peripheral medial side portion **27** of the stator core frame support **30**. The contact between the second core connecting means **44** and the stator core frame support **30**  
25 also forms a connection between the second core connecting means **44** and the stator core frame support **30**. This connection can also be a welded connection, or any other connection that forms a strong bond between metal materials.

30 The present invention provides a more efficient and cost effective power generation system **10** by low tuning the natural frequency of the generator stator core **20** while simultaneously maintaining stability of the power

generation system **10**. The stiffness of the stator core frame support **30** and biasing support member **50** is decreased, the generator stator core **20** can advantageously operate at a lower tuned natural frequency. Typical  
5 generator stator cores **20** can operate at frequencies higher than 60 hertz (HZ), while a low tuned generator stator core **20** operates at a natural frequency of less than 60 HZ. By providing a generator stator core **20** that operates at a lower tuned natural frequency, for example,  
10 between 10-25 HZ, a smaller and more efficient stator core frame support **20** can advantageously be provided in a stable power generation system **10**.

As shown in FIGS. 1-10, methods of stabilizing a power generation system **10**, relieving vibration forces,  
15 eliminating lateral movement, and low tuning the natural frequency of a generator stator core **20** are also provided in the present invention. The method includes the step of attaching a first core supporter **43** to a first upper medial side portion of a stator core frame support **30**.  
20 The first core supporter **43** preferably includes a biasing support member **50**. The method still further includes the step of attaching a second core supporter **44** to a second medial side portion of the stator core frame support **30**. The second core supporter **44** also includes a biasing  
25 support member **50**. In turn, the biasing support member **50** preferably includes an elongate spring bar **52**. The second upper medial side portion of the stator core frame support **30** is positioned opposite the first upper medial side portion of the stator core frame support **30**. The first **43**  
30 and second **44** core supporters can advantageously be attached to the stator core frame support **30** by welding portions of the first **43** and second **44** core supporters to portions of the stator core frame support **30**. The

combination of the first **43** and second **44** core supporters are positioned substantially symmetrical along portions of the stator core frame support **30**.

The method of stabilizing the power generation system  
5 **10**, and low tuning the natural frequency of the generator stator core **20** by positioning the generator stator core **20** to overlie the stator core frame support **30** advantageously provides a more cost-efficient and less complex power generation system. The lower portion **24** of the generator  
10 stator core **20** is positioned to overlie the stator core frame support **30** so that the lower portion **24** of the generator stator core **20** can be positioned within the lower inner surface **32** of the stator core frame support **30** without contact between the lower portion of the generator  
15 stator core **20** and the stator core frame support **30**.

The method of stabilizing the power generation system  
**10**, reducing vibration, eliminating lateral movement and low tuning the natural frequency of the generator stator core **20** during operation still further includes connecting  
20 the generator stator core **20** to the first core supporter **43** along a first medial side portion **27** of the generator stator core **20** and further connecting the generator stator core **20** to the second core supporter **44** along a second medial side portion **28** of the generator stator core **20**.  
25 These connections are made by using a plurality of connecting members **15**. Each one of the plurality of connecting members **15** are positioned through each of the first **43** and second **44** vibration reducers **42** and into key bars **22** positioned along outer peripheral portions of the  
30 generator stator core **20**.

The plurality of connecting members **15** can advantageously be provided by bolts, for example, or another type of connecting member that can contact each of



the first **43** and second **44** core supporters and portions  
the key bars **22** positioned along outer peripheral portions  
of the generator stator core **20**. Each of the plurality of  
connecting members **15** can advantageously be steel, or  
5 another metal material having strength properties capable  
of withstanding the vibratory forces and lateral movement  
associated with transient faults and tangential and radial  
forces associated with the "oval mode" condition  
experienced by the generator stator core **20** during  
10 operation.

The combination of the plurality of connecting  
members **15** and the first **43** and second **44** core supporters  
in contact with the first **27** and second **28** medial side  
portions of the generator stator core **20** form a connection  
15 between the generator stator core **20** and the stator core  
frame support **30** that advantageously further provides  
stabilization to the power generation system **10** during  
operation of the generator stator **20**, reduces vibration,  
eliminates lateral movement and low tunes the natural  
20 frequency of the generator stator core **20**.

The method still further includes attaching a  
plurality of keybars **22** to outer peripheral portions of  
the generator stator core **20** and positioning the keybars  
**22** spaced-apart along the outer peripheral portions of the  
25 generator stator core **20**. Each of the plurality of  
keybars **22** has a portion that includes a dovetail shape  
**26**. Each of the plurality of keybars **22** slidably contacts  
a dovetail slot **26** formed in the outer peripheral portion  
of the generator stator core **20**. The method also includes  
30 contacting the keybars **22** with the first **43** and second **44**  
core supporters **42** to thereby connect the generator stator  
core **20** to the stator core frame support **30**. The step of  
connecting the keybars **22** to the core supporters **42**

advantageously stabilizes the power generation system **10** during operation.

The step of connecting core supporters **42** to the generator stator core **20** can advantageously be  
5 accomplished by connecting the core supporters **42** to less than all of the keybars **22**. Furthermore, the step of connecting the core supporters **42** to the generator stator core **20** can also include connecting only the core supporters **42** to keybars **22** positioned along medial side  
10 portions of the generator stator core **20** so that there is no connection between the generator stator core **20** and the stator core frame support **30** along bottom surfaces of the generator stator core **20**. This method can still further include connecting the core supporters **42** to the key bars  
15 **22** positioned along medial side portions of the generator stator core **20** so that there is no connection between the generator stator core **20** and the stator core frame support **30** along upper surfaces of the generator stator core **20**. This provides an interstitial space between the lower end  
20 portion **24** of the generator stator core **20** and the lower inner surface **32** of the stator core frame support **30** and between the upper surface of the generator stator core **20** and the stator core frame support **30** that advantageously eliminates lateral forces and reduces vibration of the  
25 generator stator core **20** associated with transient faults. The interstitial space also compensates for tangential and radial forces associated with the "oval mode" condition experienced by the generator stator core **20** during operation. The interstitial space provided by the present  
30 invention still further stabilizes the power generation system **10** and low tunes the natural frequency of the generator stator core **20**.

The method of stabilizing the power generation system 10 during operation also includes extending the first core supporter 43 substantially parallel to the second core supporter 44, substantially the entire length of the generator stator core 20. The method further includes attaching a plurality of bracket spring assemblies 54 to the elongate spring bar 52. The elongate spring bar 52 can advantageously be a strong steel material. Each of the plurality of bracket spring assemblies 54 includes a spring mounting frame 56.

The method still further includes attaching first 61 and second 62 key block brackets to the spring mounting frame 56. The first key block bracket 61 includes a first key block 64 and the second key block bracket 62 includes a second key block 64. The method further includes matingly contacting each of the first and second key blocks 64 with each of the first 61 and second 62 key block brackets, and connecting the first key block bracket 61 to a first end portion of the spring mounting frame 56 and the second key block bracket 62 to a second end portion of the spring mounting frame 56. The first and second end portions of the spring mounting frame 56 are positioned opposite each other. The method still further includes connecting one of the plurality of key blocks 64 to a portion of one of the plurality keybars 22 positioned along outer peripheral portions of the generator stator core 20. The key block 64 is positioned to connect the stator core frame support 30 to the generator stator core 20.

This method of stabilizing the power generation system 10 provides an interstitial space between the upper and lower end portions of the generator stator core 20 and the stator core frame support 30 and low tunes the natural

frequency of the generator stator core **20** advantageously relieving vibratory forces associated with operation of the generator stator core **20**. The method further eliminates lateral movement associated with transient faults that occur during operation of the generator stator core **20**. The method of stabilizing the power generation system **10** during operation of the generator stator core **20** advantageously reduces the size of the stator core frame support **30**, thereby reducing costs associated with providing a stator core frame support **30**. The reduced size of the stator core frame support **30** advantageously reduces the path of a load traveling from the generator stator core **20**. Furthermore, the method advantageously allows a user or manufacturer to construct the generator stator core **20** and the stator core frame support **30** separately. When the manufacturer constructs the generator stator core **20** and the stator core frame support **30** separately, instead of simultaneously, the manufacturer is provided with more flexibility in time and cost associated with constructing the generator stator core **20** and the stator core frame support **30**.

In the drawings and specification, there have been disclosed embodiments of the invention, and although specific terms are employed, the terms are used in a descriptive sense only and not for purposes of limitation. The invention has been described in considerable detail with specific reference to these illustrated embodiments. It will be apparent, however, that various modifications and changes can be made within the spirit and scope of the invention as described in the foregoing specification and as defined in the appended claims.